Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

COMPUTING **9691/21**

Paper 2 **October/November 2015**

2 hours

Candidates answer on the Question Paper.

No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

1 **(a)** A college provides courses for the local community. The Computing teacher, Ravi, wants to develop a program to keep details of the courses. One way of storing this data will be to use records. Each record will contain the fields shown in the table below.

Complete the table.

Field	Identifier	Data type	Example of input data	Field size (in bytes)
course code	`CourseCode`		015110217	
title	`Title`		Programming for Beginners	
tutor (3-letter initials)	`Tutor`		PGL	
day of week (1 – Monday … 7 – Sunday)	`Day`		2	
lab based?	`IsLabBased`		TRUE	
session duration in hours	`SessionHours`		2.5	
fee ($)	`CourseFee`		25.50	
date course starts	`StartDate`		02/11/2015	
date course ends	`EndDate`		03/12/2015	

[5]

(b) Use a high-level programming language to define a course record with identifier `CourseRecordType` and the fields listed in **part (a)**.

Programming language .....

Code .....

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(c) Ravi decides to store course data in the array `Course`. The array will consist of 50 records.

Initially, the array elements will not contain course data.

Use the high-level language from **part (b)** to:

- declare the array `Course`
- initialise its contents with appropriate dummy values for each field

Programming language .....

Code .....

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(d) Ravi has entered some course data. His program saved the array records to a serial file `CourseData.DAT`. Only those array elements containing entered course details were saved to the file.

A program is to be written to read the data from `CourseData.DAT` into consecutive locations of the array `Course`.

(i) Explain what the function `EOF()` does when used in a program.

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Ravi wants to write another module in his program. The new module will:

- read data from `CourseData.DAT`
- write these data into consecutive elements of the array `Course`

(ii) Write **pseudocode** to read the data from the file `CourseData.DAT` into the array `Course`.

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(e) Ravi wants to write a procedure to sort the records in the array `Course`. The records will be sorted into ascending order of course fee. The array contains records for each course provided. The remaining array elements contain dummy records.

One of his students has written a sorting algorithm:

```
PROCEDURE SortData
   FOR x ← 1 TO 49
      FOR y ← 1 TO 49
         IF Course[y].CourseFee > Course[y + 1].CourseFee
            THEN
               TempRecord ← Course[y]
               Course[y] ← Course[y + 1]
               Course[y + 1] ← TempRecord
         ENDIF
      ENDFOR
   ENDFOR
ENDPROCEDURE
```

An integer variable, `NumberOfCourses`, will contain the number of courses for which data are stored in the array.

Improve the algorithm so that no unnecessary comparisons are made.

```
PROCEDURE SortData(NumberOfCourses)
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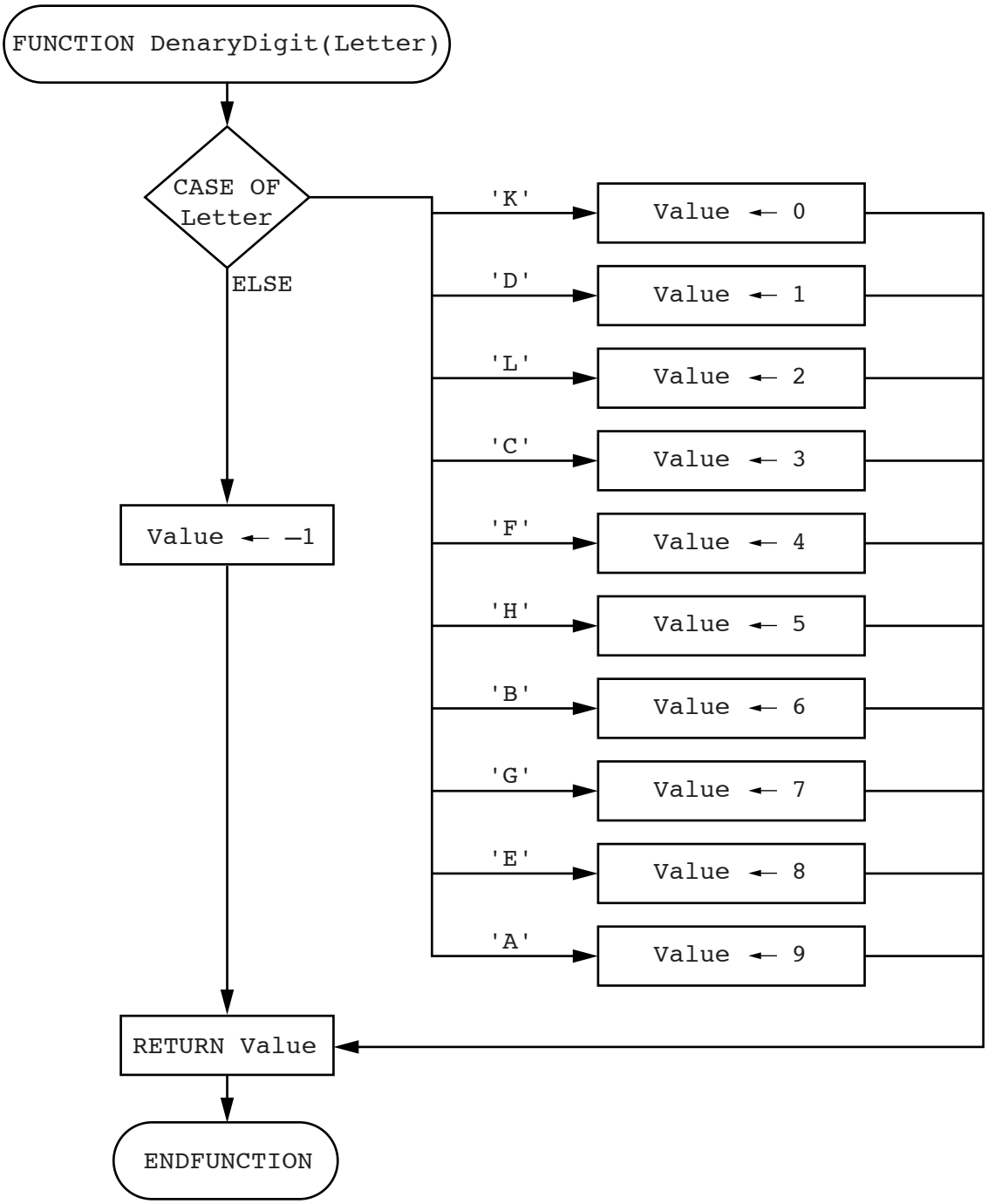
2 Alia received a number coded as a sequence of letters. She wants to write a program to change this sequence of letters back to the original number. She knows that each digit of the original number was replaced by exactly one letter. The letters used are shown in the flowchart below.

She has drawn the flowchart as part of the design for her solution.

The function `DenaryDigit(Letter)` returns an integer.



(a) (i) Write the program code to implement the function `DenaryDigit` from its flowchart design. Use a high-level programming language.

Programming Language .....

Code .....

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(ii) Alia needs to test this function before using it in her program.

Complete the table of test data.

`Letter`	**Expected result**	**Type of data** (normal, borderline or invalid)
`'1'`		
`'X'`		
`'G'`		

[3]

(b) Alia writes pseudocode to convert a coded number using

- the function `DenaryDigit()` from **part (a)**
- the string manipulation functions `MID()` and `LENGTH()`

Study the pseudocode:

```
01 PROCEDURE ConvertToDenary(CodedNumber : STRING)
02
03    Denary ← 0
04
05    FOR i ← 1 TO LENGTH(CodedNumber)
06       ThisChar ← MID(CodedNumber, i, 1)
07       ThisNumber ← DenaryDigit(ThisChar)
08       Denary ← Denary + (ThisNumber * 10)
09    ENDFOR
10
11    OUTPUT Denary
12 ENDPROCEDURE
```

(i) Dry-run the procedure call `ConvertToDenary("LED")` by completing the trace table.

CodedNumber	Denary	i	ThisChar	ThisNumber	OUTPUT
"LED"	0				

[5]

(ii) The denary value of the coded number LED is 281. There is an error in the pseudocode above.

Give the line number of the statement that needs correcting.

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Write the corrected statement.

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(iii) State the type of error Alia made in her pseudocode.

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(iv) There are **two** other types of error that can occur when writing or executing program code.

Name each type of error and describe when and how it is detected.

Error type 1 .....

When .....

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How .....

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Error type 2 .....

When .....

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How .....

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(c) (i) The pseudocode in **part (b)** has some features that make it easier to read and understand.

State **three** such features.

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(ii) State **one** other feature Alia could have used to help the understanding of this code.

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(iii) Write program code to implement the pseudocode given in **part (b)**.

Remember to declare variables before you use them.

The code is repeated here so that you do not need to turn back to **part (b)**:

```
PROCEDURE ConvertToDenary(CodedNumber : STRING)

   Denary ← 0

   FOR i ← 1 TO LENGTH(CodedNumber)
      ThisChar ← MID(CodedNumber, i, 1)
      ThisNumber ← DenaryDigit(ThisChar)
      Denary ← Denary + (ThisNumber * 10)
   ENDFOR

   OUTPUT Denary
ENDPROCEDURE
```

Programming Language .....

Code .....

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(iv) The parameter of `ConvertToDenary` might not be a valid coded number.

An error message is to be output if the string provided as a parameter is not valid.

Describe the changes required to the code design.

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3 Ravi and Alia want to use debugging tools available in their program development environments.

(a) Explain how each of the following are used**:**

(i) Breakpoint

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(ii) Stepping

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(iii) Variable check/watch

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(b) Name the type of testing that is performed with such debugging tools.

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